

IN THE SPECIFICATION:

Please replace paragraph numbers [0001], [0003]-[0006], [0008]-[0012], [0014], [0029], [0031]-[0034], [0039], [0043], [0045], [0046], [0049]-[0053], [0056], [0057], [0060], [0062], [0066], [0070], and [0072]-[0074] with the corresponding paragraph below. A marked-up version showing the amendments is included in the attached Appendix.

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[0001] The present invention relates to an image processing apparatus suitable for preventing counterfeiting of copy-prohibited objects, such as paper money, securities and the like.

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[0003] A copier is basically designed to faithfully copy an object mounted on an original-mount, except for a copy-prohibited object, such as paper money or the like. Accordingly, if an image which resembles paper money (an image other than paper money which can be legally copied) is input, the copier must recognize that the image is not paper money, and perform a copying operation of the original image. Hence, very precise recognition accuracy is requested for determining whether or not an image to be recognized is an image for which counterfeiting is to be prevented.

[0004] Recently, the quality of an image obtained by a color scanner or a color printer, which is less expensive than a color copier, is greatly improved, and it

becomes possible to perform a counterfeiting operation by connecting such an apparatus to a personal computer, i.e., by combining apparatuses other than a color copier. Accordingly, even in an image processing system using an inexpensive color scanner or color printer, countermeasures for preventing counterfeiting of paper money, securities and the like by mounting an image recognition function or the like have been desired.

[0005] Various methods for determining whether or not an original is a copy-prohibited object have been proposed. In one method, a color spectrum distribution of image data obtained by scanning an original is compared with data registered in advance in a ROM (read-only memory), based on each pixel value (a set of R, G and B values corresponding to three color signals) in the image data (for example, by obtaining a sum of the absolute values of difference values between respective pixel values and stored data, or calculating a cross-correlation value between distributions). In another method, an evaluation value is calculated by comparing a synthetic image pattern of a part or the entirety of an original with pattern data registered in advance in a ROM or the like.

[0006] Recently, it became possible to incorporate information indicating a copy-prohibited object within an original, serving as a printed matter, using a technique called "digital watermark". That is, when printing an original, serving as a copy-prohibited object, a printed matter is obtained from image data (electronic image information) including copy-prohibited-object information generated by embedding second digital information (sub-information) indicating

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registered in advance in a ROM, or by calculating an evaluation value by comparing a synthetic image pattern of a part or the entirety of the original with pattern data registered in advance in a ROM or the like, if the direction (angle) or the position of the mounted original is not fixed, the total amount of calculation operations for comparison with spectrum data registered in advance or image-pattern data tends to greatly increase in order to deal with various directions and positions.

[0010] In an inexpensive color scanner or color printer, it is desirable to prevent counterfeiting of a copy-prohibited object with a cost lower than in the case of using a relatively expensive color copier. For that purpose, it is preferable to recognize a copy-prohibited object by mainly using software instead of mainly using hardware having a large amount of electronic circuits and the like.

[0011] On the other hand, when determining a copy-prohibited image requiring precise recognition accuracy mainly by software, the total amount of calculation operations is large, and the processing time required for the recognition and determination tends to be greatly increased.

[0012] That is, if the amount of calculation operations for the recognition and determination is reduced, it generally tends to be difficult to determine a copy-prohibited image requiring precise recognition accuracy such that, for example, it becomes difficult to detect a copy-prohibited object, such as paper money or the like, read by intentionally changing reading conditions (such as a mounting angle or a mounting position of an original on a reading surface), or that when an

A3 image resembling paper money (an image other than paper money which is legally allowed to be copied) is input, the image is erroneously recognized as a copy-prohibited image and normal image output is not performed, thereby impairing the original function of an image processing system.

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A4 [0014] It is another object of the present invention to provide an image processing apparatus and a method for controlling the same which allow recognition of whether or not an image is a copy-prohibited object that is more precise than in the prior art, even in recognition/determination processing having a relatively small amount of calculation operations in a personal computer system using an inexpensive image scanner or color printer.

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A5 [0029] FIG. 11 is a flowchart illustrating another operation procedure in the seventh embodiment.

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A6 [0031] An image processing apparatus proposed in the following embodiments of the present invention includes, as shown in FIG. 1, an image-data acquisition unit 120 for inputting image data from an image-data source 110, such as a color scanner or the like, a copy-prohibited-object recognition unit 130 for determining whether or not the image data obtained by the image-data acquisition unit 120 is image data obtained by reading a copy-prohibited object, a retry determination unit 160 including a difficulty calculation unit 140 for calculating the difficulty in

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data represents a copy-prohibited object and it is preferable to again read the original by a device for reading (generating) image data, such as a scanner or the like, the control unit 200 outputs a signal to request (or recommend) to again read the original by the image-data reading (generating) device to the retry-information reception unit 180 via the retry-information transmission unit 170 , in order to obtain an input image for which it is easier to determine a copy-prohibited object.

[0033] In the following first embodiment of the present invention, a description will be provided of a case in which information indicating a copy-prohibited object included within an original is formed according to a technique called "digital watermark " That is, it is assumed that an original, serving as a copy-prohibited object, is formed from image data (electronic image information) including copy-prohibited-object information generated by embedding second digital information indicating a copy-prohibited object in image data (electronic information), serving as first digital information to be formed as a printed matter.

[0034] The digital watermark may have any appropriate form, such as an invisible digital watermark in which information is embedded in spatial frequencies of image data, a visible digital watermark in which information is embedded according to an arrangement of yellow (or yellow-type) dots which are difficult to be seen by human eyes, or the like.

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[0039] FIG. 3 is a block diagram illustrating a principal portion in the configuration shown in FIG. 2 as functional modules. In FIG. 3, there are shown a CPU (central processing unit) 11, a RAM (random access memory) 12, a ROM 13, a display control unit 14, a display 15, an operation input device 16 including a keyboard, a mouse and the like, an input/output control device (hereinafter abbreviated as an I/O 17 for connection to the operation input unit 16, an external storage device 18, such as a hard-disk device or the like, an I/O 19 for connection to the external storage device 18, a bus 20, a color image scanner 21, an I/O 22 for connection to an image input device, such as a color image scanner or the like, through the connection cable 3, and an interface unit 23 operating as an interface with communication means, such as a network or the like.

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[0043] In step S30, it is determined whether or not the read image has an angle (at least a predetermined angle  $\theta_{th}$ ) at which detection of a copy-prohibited image is difficult in recognition/determination processing with a relatively small amount of calculation operations. If the result of the determination in step S30 is affirmative, the process proceeds to step S40. If the result of the determination is negative, the process proceeds to step S50.

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[0045] In step S60, the presence of characteristics of a copy-prohibited object in the image data obtained in step S50 is checked. The process then proceeds to step S70.



AG [0046] In step S70, it is determined whether or not the image is a copy-prohibited image based on the result of the check in step S60. If the result of the determination in step S70 is affirmative, the process proceeds to step S80. If the result of the determination in step S70 is negative, the process proceeds to step S90.

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AD [0049] In step S40, the CPU 11 outputs a signal indicating that the mounting angle  $\theta$  of the original on the reading surface of the scanner is an angle (at least  $\theta_{th}$ ) at which detection of a copy-prohibited image is difficult, and requesting to again read the original by changing the mounting state, to the display device 15 via the display control unit 14. Upon completion of step S40, the series of processing is terminated. In accordance with the result of the output, the display device 15 displays the mounting angle of the original in the form of an image.

[0050] In the above-described step S80, the operation that (4) image data is not output at all may, of course, be performed instead of outputting a certain image data file. The operation that (5) a signal indicating a warning that the original is a copy-prohibited object is output to the display device 15 via the display control unit 14 may, of course, also be performed.

[0051] In the processing of calculating the mounting angle of the original on the original-reading surface performed in step S20, the angle of the original is detected by detecting the positions of edges of the original for each scanning line by detecting the difference between the pixel density value when reading the

platen cover of the scanner and the pixel density value when reading the background portion of the original, and detecting the positions of the four corners of the original based on information relating to changes in the positions of the edges of the original.

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[0052] The check of the characteristics of a copy-prohibited object in step S60 is performed by extracting the characteristics from image data obtained by performing photoelectric scanning of the original, serving as a printed matter including information relating to a copy-prohibited object using the above-described digital-watermark technique, by the scanner.

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[0053] In step S70, it is determined whether or not information relating to a copy-prohibited object has been extracted in step S60. If the result of the determination in step S70 is negative, the process proceeds to step S90. If the result of the determination in step S70 is affirmative, the process proceeds to step S80.

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[0056] Although in the above-described first embodiment, the check of the characteristics of a copy-prohibited object in step S60 is performed by extracting the characteristics from image data obtained by performing photoelectric scanning of the original, serving as a printed matter including copy-prohibited-object information using the digital-watermark technique, any other appropriate approach may also be adopted. The check of the characteristics of a copy-prohibited object in step S60 may be performed by comparing a color-spectrum

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digital image obtained by reading the original on the original-mount (platen) and calculating the mounting position of the original (the coordinates of the four corners of the original) as shown in step S21 of FIG. 5, and the process of step S30 in FIG. 4 may be replaced by a determination of whether or not the mounting position of the original coincides with a predetermined standard position as shown in step S31 of FIG. 5. If the result of the determination in step S31 is affirmative, the process eventually proceeds to step S70 assuming that the determination of a copy-prohibited object is not difficult. If the result of the determination in step S31 is negative, the process proceeds to step S41. The process of outputting a signal requesting to change the mounting angle of the original in step S40 of FIG. 4 is replaced by the process of outputting a signal requesting to change the mounting position of the original as shown in step S41 of FIG. 5. Other portions are entirely the same as in the first or second embodiment.

[0060] Although in the above-described first through third embodiments, the calculation of difficulty in determination whether or not an image is a copy-prohibited object shown in step S20 or S21 is performed from an image obtained by pre-scanning shown in step S10, the present invention is not limited to such an approach. That is, actual scanning performed in step S50 may be performed in step S10. The image read in this actual scanning may be stored in the RAM 12 or

A12 the external storage device 18, and the stored image may be processed at the processing starting from step S60.

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A13 [0062] Although in the above-described first through fourth embodiments, the characteristics of a copy-prohibited object are checked for the image read by the scanner, the present invention is not limited to such an approach.

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A14 [0066] Although in the above-described first through fifth embodiments, image data is output to the external storage device 18 (a hard disk or the like within the image processing system) via the I/O 19 as an image data file, whether the image data is output as normal image data or abnormal image data, the present invention is not limited to such an approach.

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A15 [0070] In this case, output of image data in step S80 or S90 in the flowchart of FIG. 4 or 5 is realized by output of image data to the color printer 24 connected to the image processing system via the I/O 25, through connection cable 5.

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A16 [0072] Although in the above-described first through sixth embodiments, the presence of characteristics indicating whether or not input image data represents a copy-prohibited object is determined, the present invention is not limited to such an approach.

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